

Montana Model Curriculum Framework		
Unit of Study: The Periodic Table and Periodicity		Grade: High School Physical Science
Suggested Timeframe: Three Weeks		
Unifying Concepts: Patterns, Relationships, Order, Structure		
Enduring Understandings	Essential Questions	Content Standards, Benchmarks, and Essential Learning Expectations
<ol style="list-style-type: none"> Observed patterns in nature guide organization and classification. Observed patterns prompt questions about relationships and causes underlying them. Patterns exist everywhere in regularly occurring shapes or structures, repeating events, or repeated relationships. The arrangement of the Periodic Table is based on structures, patterns and relationships. The elements, arranged by increasing atomic number, exhibit periodic trends in properties. Chemical and physical properties of an element are determined by the element's structure. The Periodic Table is dynamic as a result of scientific discovery. 	<ol style="list-style-type: none"> How does the placement of an element in the Periodic Table relate to its chemical and physical properties? Why is the Periodic Table called the "Periodic" Table, not just the "Table of Elements"? How does knowing trends on the Periodic Table help scientists predict properties of the representative elements? In what ways does the information contained in the Periodic Table help us to discover new elements? 	<p>Content Standard 2—Students, through the inquiry process, demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.</p>
		<p>Benchmark Upon Graduation 2. Explain how the particulate level structure and properties of matter affect its macroscopic properties, including the effect of (a) valence electrons on the chemical properties of elements and the resulting periodic trends in these properties, (b) chemical bonding, (c) molecular geometry and intermolecular forces, (d) kinetic molecular theory on phases of matter, and (e) carbon-carbon atom bonding on biomolecules.</p>
		<p>ELE A: Recognize the Periodic Table is organized based on a series of repeating patterns</p> <p>ELE B: Utilize the Periodic Table to determine the number of valence electrons of an element</p> <p>ELE C: Utilize the Periodic Table to predict, from neutral atoms, the formation of ions with the number of electrons gained or lost (10)</p> <p>ELE D: Recognize that chemical properties of elements change with the number of valence electrons</p>

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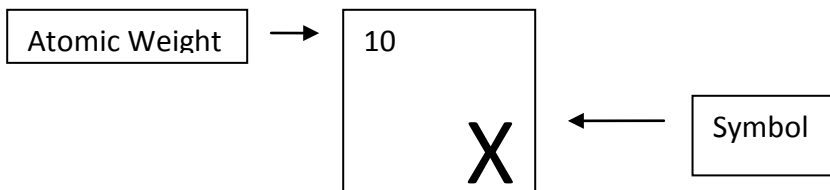
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Assessments

Suggested Formative Assessment

1. Choose something in your world that exhibits periodic behavior. State what it is and explain in what way it demonstrates periodicity. The example and explanation given should include the following components: A) There must be a definite, observable pattern that occurs; B) The pattern must repeat itself; and, C) Due to the repetition of the pattern, it should be possible to make predictions from the pattern.
2. Using the Flinn Chem Topics™ Zodiac Periodic Table Activity (given in Resources), create a Periodic Table with imaginary elements of various physical and chemical properties, and use the repeating pattern to predict the properties and placement of an unknown element.
3. Below is a periodic table of elements. Within each box you may locate the following information:



Examine the periodic table below. Please notice that information is missing for element A. Then answer the questions which follow.

10 X	12 Y	14 J	16 Q	19 G
27 L	28 W	31 Y	? A	36 Z
70 K	73 E	75 R	80 T	85 M

Questions

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1. The following compounds are the results of reactions between various elements from the periodic table: **XQ**, **X₂J**, **YQ₂**, **L₂J**, and **YD**. Element G does not form compounds with the other elements. Write formulas for compounds resulting from reactions between:
 - a) L and A
 - b) K and D
 - c) W and J
 - d) E and A
 - e) W and Z
2. Give reasons for your answers in question 1.
3. Predict the atomic weight of element A. Give reasons for your answer.

Suggested Performance Assessment: GRASPS

When constructing performance assessment tasks, it helps to use the acronym GRASPS:

G Real-world Goal

R Real-world Role

A Real-world Audience

S Real-world Situation

P Real-world Products or Performances

S Standards

GOAL

Provide a statement of the task.

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Establish the goal, problem, challenge, or obstacle in the task.

ROLE

Define the role of the students in the task.

State the job of the students for the task.

AUDIENCE

Identify the target audience within the context of the scenario.

Example audiences might include a client or committee.

SITUATION

Set the context of the scenario.

Explain the situation.

PRODUCT

Clarify what the students will create and why they will create it.

STANDARDS and CRITERIA [INDICATORS]

Provide students with a clear picture of success.

Identify specific standards for success.

Issue rubrics to the students or develop them with the students.

(SEE EXAMPLE BELOW)

GRASPS Example

Goal: The goal is to persuade a pharmaceutical company that an element may be used for a diagnostic technique in medicine.

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Role: You are an engineer with a Ph.D. in Nuclear Medicine.

Audience: The target audience members are high-level executives from a well-known pharmaceutical company.

Situation: You must convince high-level executives in a well-known pharmaceutical company that a particular element may now be used for a diagnostic technique in medicine (e.g., a Pet Scan or Gamma camera).

Product: You need to design a presentation (Prezi, PPT) to share with your audience that will persuade them to utilize the particular element diagnostically. You must justify the element's use for this application including how it can potentially react to other things in the body as well as to other elements potentially present in the equipment.

Standards: Your presentation should: (a) provide justification for the diagnostic use of this element over others, (b) reference the Periodic Table, (c) include background information on the element you have selected that is scientifically sound, and (c) provide research that supports your conclusions (e.g., Web sites, journal articles).

Students should be encouraged to develop their own "GRASPS" assessment that is based on their interest and indicates an understanding of the Periodic Table. Suggested components of the GRASPS (roles, audience, etc.) can be found below:

"GRASPS" Possible Student Roles and Audiences

actor

celebrity

editor

historian

museum
visitor

police officer

storyteller

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advertiser	carpenter	elected official	historical figure	neighbor	pollster	student
artist/illustrator	CEO	embassy staff	illustrator	newscaster	radio listener	taxi driver
author	chairperson	engineer	intern	novelist	reader	teacher
biographer	chef	expert (in _____)	interviewer	nutritionist	reporter	tour guide
board member	choreographer	eyewitness	inventor	observer	researcher	trainer
boss	client/customer	family member	judge	panelist	reviewer	travel agent
Boy/Girl Scout	coach	farmer	jury	parent	sailor	traveler
businessperson	community member	filmmaker	lawyer	park ranger	school official	tutor
candidate	composer	firefighter	library patron	pen pal	scientist	TV viewer
carpenter	construction worker	forest ranger	literary critic	photographer	ship's captain	TV or movie character
cartoon character	dancer	friend	lobbyist	pilot	social scientist	Visitor
cartoonist	designer	geologist	meteorologist	playwright	social worker	Web site designer
caterer	detective	government official	museum director/curator	poet	statistician	Zookeeper

"GRASPS" Possible Products and Performances

Written

Oral

Visual

Science Unit of Study: Periodic Table, High School

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advertisement	letter	Story	audiotape	skit	advertisement	game	storyboard
biography	log	test	conversation	song	banner	graph	videotape
book report or review	magazine article	website	debate	speech	cartoon	map	website
brochure	memo		discussion	teach a lesson	collage	model	Prezi
collection	newscast		dramatic reading	Podcast	computer	painting	
graphic	newspaper article		dramatization	Prezi	data display	photograph	
crossword puzzle	play		interview		design	poster	
editorial	poem		oral presentation		diagram	PowerPoint	
essay	position paper		oral report		diorama	Podcast	
experiment record	proposal		poetry reading		display	questionnaire	
historical fiction	research report		puppet show		drawing	scrapbook	
journal	script		radio script		filmstrip	sculpture	
lab report	show		rap		flyer	slideshow	

Constructing a Performance Task Scenario Using GRASPS

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Consider the following set of stem statements as you construct a scenario for a performance task. Refer to the tables above to help you brainstorm possible scenarios. Note: These are idea starters. Resist the urge to fill in all of the blanks!

Goal

- Your task is _____
- Your goal is to _____
- The problem or challenge is _____
- The obstacle to overcome is _____

Role

- You are _____
- You have been asked to _____
- Your job is _____

Audience

- Your clients are _____
- The target audience is _____
- You need to convince _____

Situation

- The context you find yourself in is _____
- The challenge involves dealing with _____

Constructing a GRASPS (cont'd)

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Product, Performance, and Purpose:

- You will create a _____ in order to _____
- You need to develop _____ so that _____

Standards and Criteria for Success:

- Your performance needs to _____
- Your work will be judged by _____
- Your product must meet the following standard (quality) _____
- A successful result will _____

Adapted From Wiggins, Grant and Jay McTighe. *Understanding by Design Professional Development Workbook*. Alexandria, VA: Association for Supervision and Curriculum Development. 2004.

Performance Rubrics

Montana Science Content Standard 2: Benchmark 2: ELE A-D, Grades 9-12

Big Idea Essential Learning Expectation (ELE A-D): Periodic Table and Chemical Properties

Criteria	Novice	Nearing Proficiency	Proficient	Advanced
Periodicity	Student demonstrates an incomplete and inaccurate understanding, that a series of repeating patterns organize the Periodic Table.	Student demonstrates a general understanding that a series of repeating patterns organize the Periodic Table.	Student demonstrates a complete understanding that a series of repeating patterns organize the Periodic Table.	Student understands that a series of repeating patterns organize the Periodic Table and can re-organize and justify these patterns.
Valence Electrons	Student inaccurately identifies the number of valence electrons of an element utilizing the Periodic Table.	Student, with prompting, identifies the number of valence electrons of an element utilizing the Periodic Table.	Student identifies the number of valence electrons of an element utilizing the Periodic Table.	Student uses multiple methods to determine the number of valence electrons of an atom
Ion Formation	Student, with assistance, identifies the ions of atoms without understanding the relationship to valence electron.	Student, with assistance, predicts from neutral atoms, the formation of ions with the number of electrons gained or lost.	Student predicts from neutral atoms, the formation of ions with the number of electrons gained or lost.	Student applies the formation of ions and the number of electrons gained and lost to predict chemical properties and reaction products.
Chemical Properties	Student, with prompting, describes a chemical property without understanding the relationship to valence electrons.	Student, with prompting, describes how chemical properties vary when the number of valence electrons changes.	Student describes how chemical properties vary when the number of valence electrons changes.	Student takes an original, unique and imaginative approach when describing how chemical properties vary when the number of valence electrons changes.

Language of the Standards

Valence electrons, periodicity, ionization energy, atomic, alkali metals, alkaline earth metals, halogens, noble gases, cation, anion, transition metals, electron configurations

Additional Information	
<p>Common Misconceptions</p> <ol style="list-style-type: none"> 1. The Periodic Table provides only an element's name, symbol, atomic number, and atomic mass. 2. The more subatomic particles contained in an atom, the larger the atom. 	<p>Proper Conceptions</p> <ol style="list-style-type: none"> 1. Elements are placed on the Periodic Table according to repeating patterns of physical and chemical properties, as well as reactivity patterns. 2. Atomic size decreases going across a period of the table due to increasing nuclear charge. Atomic size increases down a group of elements due to addition of energy levels.

Resources for Teachers

Abraham, M.R., E. B. Grzybowski, J.W. Renner, and E.A. Marek. "Understanding and Misunderstandings in Eighth Graders of Five Chemistry Concepts Found in Textbooks." *Journal of Research in Science Teaching*, 1992, 105-120.

Flinn ChemTopic™ Labs Experiments & Demonstrations in Chemistry. The Periodic Table, Volume 4. The source includes a collection of demonstrations and labs dealing with periodicity.

The following two books present the history of chemistry in an easy to read and anecdotal fashion:

Jaffe, Bernard: Crucibles: The Story of Chemistry, Dover Publications, Inc. New York, New York, 1976.

A Short History of Chemistry Isaac Asimov Educational Services Incorporated, 1965

[World's Largest Periodic Table of Elements](#)

This link provides an article about how the city of Chicago created a Periodic Table that is eight stories tall. It may be used to introduce the unit or during the course of instruction.

<http://webserver.lemoyne.edu/faculty/giunta/mendeleev.html>

This source has a copy of Mendeleev's paper, *On the Relationship of the Properties of the Elements to their Atomic Weights*, and Periodic Table presented to the Russian Chemical Society in 1869.

www.radiochemistry.org

This link provides a variety of chemistry activities that includes the Periodic Table.

<http://www.ptable.com/>

This link takes the user to a "Dynamic Periodic Table" that is useful for showing students information about all of the elements.

<http://www.periodicvideos.com/>

This link includes videos with information about each of the elements on the Periodic Table.

<http://solar-center.stanford.edu/AO/bighorn.html>

This link provides information and videos about the Native American "Medicine Wheel" in the Bighorn Mountains of Wyoming.

Cross-Curricular Content Standards, Benchmarks, and Essential Learning Expectations

Mathematics Content Standard 2.1 Representing and Analyzing Data: Select, create, and compare graphical or numerical representations of data sets using technology when appropriate. Reason about distributions using measures of central tendency and spread (e.g., percentiles, quartiles, inter-quartile range, and standard deviation).

Information Literacy/Library Media Standard 2: locate sources, use information and present findings.

Technology Standard 3: Students must apply digital tools and skills with creativity and innovation to express themselves, construct knowledge, and develop products and processes.

Indian Education for All Connections

Early Native American calendars were based on astrological observations of stars and the moon, exhibiting repeating patterns that allowed for predictions (periodicity). The oldest of these calendars are stone “medicine wheels,” found in Montana, Saskatchewan and Wyoming.

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